Poster III-42

Medical Image-Guided Mesh Generation and Registration for Anatomically Accurate Biological Models

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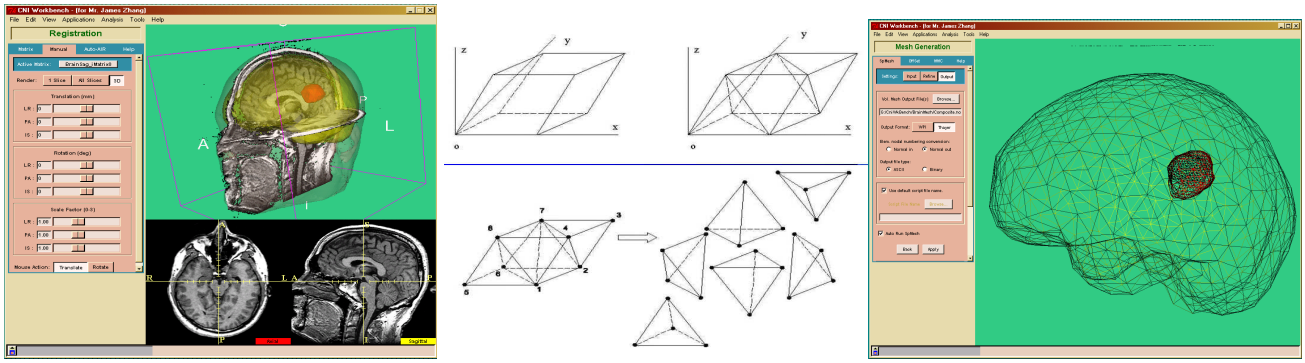
An accurate 3D mesh model of a brain is fundamental for analysis and treatment simulation. Generally the raw data of a patient's brain comes from MRI images. The boundary surfaces are extracted from segmented regions on the image slices, which are used as the input for 3D volume mesh generation. Generally, the mesh preparing is a time consuming process. It is significant to shorten the meshing process for the simulation. For some reasons the resultant volume mesh, specific to the patient's brain, may misaligned to a standardized human brain atlas. This problem can be resolved by registration between images and geometry. Here we combined mesh generation with image registration and use inter-modality registration to align subject-specific volume mesh geometries to standard atlas images. It can efficiently generate anatomically accurate biological models for analysis.

Atlases are fundamental to brain image analyses and serve as standardized templates on which other brain maps can be overlaid, for comparisons and integrations. Transforming MR intensity-based images onto a segmented 3D brain atlas mitigates subject-specific shape variations and allows subsequent comparisons of brain functions between multiple subjects[1].

An intuitive graphical user interface (GUI) was developed that integrated image registration and mesh generation processes. It provides a means to record every step of a registration process yielding an affine transformation matrix that incorporated both image data and geometry objects into the same working space. In the manual-registration mode the user can specify the affine parameter adjustments relative to the current state of the dataset. Transformation results are immediately available in 2D and 3D visualization windows. Fiducial marks can also be used to help on the registration process. High quality aligned mesh elements are generated through the 3D automatic mesh generator. An innovated deltahedral building block is used for the mesh generation process[2]. The results are shown in following figures.



The topologic relationship of the brain image is important to image registration. An accurate registered 3D mesh model of a brain is critical for analysis and treatment simulation. An intuitive GUI for boundary and volume mesh registration provided a means to fulfill this task.

This work was supported, in part, with funding from NCI P01-CA80139

References

1. Toga, A.W. and Mazziotta, J.C. eds. (1996). "Brain Mapping: The Methods", Academic Press, San Diego.
2. Zhang, J.Q. and Sullivan, J.M. Jr., "Three dimensional mesh generation using a deltahedral building block for anatomically accurate biological models", presented: 5thUS Nat. Congress Comp Mechanics 1999, Aug. 1999.